Water Management Act Blue Ribbon Panel Meeting

Boston, MA

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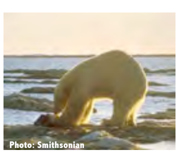
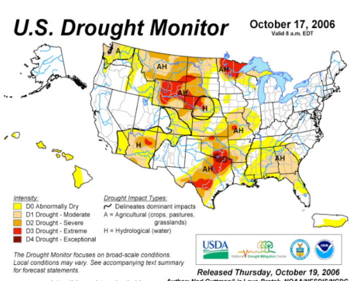
Biography of Amy Vickers

- MWRA Water Capital Engineering, 1987-89
  - Author of 1988 MA 1.6 gpf toilet plumbing code amendment
  - Author of national water efficiency standards for toilets, urinals, showerheads and faucets, 1992 *U.S. Energy Policy Act*
- Brown and Caldwell Engineers, 1989-91
- Amy Vickers & Associates, Inc., 1991-present
  - 100+ water conservation projects in U.S., Canada, overseas
- Author, *Handbook of Water Use and Conservation: Homes, Landscapes, Businesses, Industries, Farms* (WaterPlow Press)
- Active AWWA member–committees, AWWARF, *Journal AWWA*
- Education
  - M.S. Engineering, Dartmouth; B.A. Philosophy, NYU
- Favorite bumper sticker
  - *"Don't believe everything you think"*

New U.S. Water Reality: Chronic Droughts, Shortages, Water Fights.





Source: U.S. Drought Monitor, http://www.drought.unl.edu/dm/monitor.html.

Study: __Human activity produces drought__

NEW YORK, May 17 [2006] (UPI) -- Columbia University scientists have linked recent water shortages in the northeastern United States with human activities.

Researchers at The Earth Institute say the recent water emergencies in some northeastern states resulted from more than just dry weather. **They found droughts had a more direct, human cause called demand-driven drought.**

Permanent Water Conservation Programs Can Boost Water Systems' Drought Resistance

- The more water-efficient a system is, the better prepared it is to respond to drought when it occurs.
- Allowing excess water use during non-drought times strains human-made and natural water systems, increasing the frequency of drought conditions.
- A water-tight system, realized by active implementation of water conservation standards, measures and practices, can result in fuller reservoirs and more robust streams and ground water supplies. When a drought hits, these water supply savings are more readily available to a water-efficient system than one that operates inefficiently.

Cost Differences for New Water Infrastructure vs. Conservation

Supply-side *(new source development)*

- Surface/Ground, $0.75-3 million/mgd + O&M
- Reuse, $1-3 million/mgd + O&M
- Desalination, $3-6 million/mgd + O&M, pollution
  - O&M: $250-$3,000/mg
  - Risks: political, waste management, environment

Demand-side *(conservation)*

- $0.25-$1.0 million/mgd

"Final Report: Water Conservation Planning USA Case Studies Project"

Prepared for UK Environment Agency, Demand Management Centre (Vickers Inc., June 1996).

TABLE 3-3

SUMMARY OF CONSERVATION PROGRAMME COSTS AND BENEFITS (1996)

Water Utility	Cost of Capacity Expansion Options	Conservation Programme Costs, Est.	Avoided Cost Savings (Benefits)		Approximate Benefit-Cost Ratio	Impact of Conservation In Delaying System Capacity Expansion Schemes
			Capital	Operating		
Massachusetts Water Resources Authority	£89-396 million (1990)	£22.1 million (1986 budget)	£89-396 million (1990)	NA	> 4	Indefinite
New York City DEP	£1.9-2.8 million per Ml/d (1995)	£0.6-0.7 million per Ml/d, toilet rebate programme only (1994-1997 budget)	£1.3-2.0 million per Ml/d	£33 million/year	> 3	Indefinite (water supply), 10 years (wasteswater)
United Water/New York	£53.3 million (1996)	£0.82 million (actual 1993-1995)	£1.95 million (1990)	NA	> 2	5-6 years
Cape May Water & Sewer Utility	£3.3 (1996)	£33,300 (actual 1987-1995)	NA	£10,000 (City fixture replacements only)	> 2	3 years

NYC Conservation Program Results

Source: NYC DEP, http://www.nyc.gov/

- **Total system-wide reduction: 27% (400 mgd)**
  - **1991 = 1.5 bgd (high)**
  - **2005 = 1.1 bgd**
- 1990s era $300+ million conservation program averted $1.2 billion WWTP expansion (net $900 million capital savings) plus:
  - >$240 million savings in sizing of aeration tanks for nitrogen removal
  - >$1 million savings in WWTP electricity costs
  - Decreased dry weather flows have increased storage capacity for some CSOs
- 1.3 million low-volume toilets installed, avg, savings 69 gal/day/apt
- Distribution system losses down 80-90% compared to mid-80s
- Hydrant locks saved 80 mgd on days above 90°F
- 2006 "Dependability Program"
  - Goal of no increase in water demands over next 20-30 years
  - Conservation program expansion

Austin, TX Water Conservation Program

- Driver: Treatment capacity
- 2005 program budget: $2.93 million
- Staff size: 14
- 5-day watering schedule, May-September
- Conservation Tier:
  - **4th: over 15,001 gal/mo, pay $6.91/1000 gal (over 500 gd)**
  - 3rd, 9001-15000 gal/mo, pay $3.88/1000 gal (300-500 gd)
  - 2nd, 2001-9000 gal/mo, pay $2.30/1000 gal (67-300 gd)
  - 1st, 0-2000 gal/mo, pay $0.88/1000 gal (<67 gd)

Protecting Revenues While Saving Water

***Anticipate** demand reductions and have rate changes in place early to minimize or avoid revenue losses!*

- Incorporate projected water savings into projections
- Adjust rates; may be more frequent in early years
- Key message to public
  - "Your water *rate* may increase, but if you conserve, you water *bill* (costs) should be about the same–possibly less than before."
- Establish revenue stabilization funds
- <u>Many water systems have achieved demand reductions from conservation - they are not in the red.</u>

Performance Indicators: ***Tools to Measure Water Waste–and Efficiency***

Water managers responsible for achieving water savings from conservation programs need benchmarks or performance indicators, too. Not unlike the BMI–body mass index–benchmark for human body weight, few may want to get on the water efficiency scale, but doing so clarifies how efficiently (or not) water is being used.

Water efficiency is measured in gallons, not promises!

Unaccounted-for Water Performance Indicators

MA's 10% UFW performance indicator is fair and reasonable. Some systems have UFW rates of less than 10%

"Fixing Leaks Can Avert World Water Woes, Expert Says"

–Stockholm, August 22, 2006, Reuters

Water System Leakage and Losses, Worldwide

Country	Service Area	Est. Avg. Losses of Total Water Supplied
United States	**nationwide**	**10% to 30%**
Albania	nationwide	up to 75%
Canada	Kingston, Ontario	38%
Czech Republic	nationwide	20% to 30%
Denmark	Copenhagen	3%
England	nationwide	950 mgd
	London	244 mgd
France	Paris	30%
	nationwide	up to 50%
Japan	Fukuoka	5%
Jordan	nationwide	48%
Kenya	Nairobi	40%
Singapore	nationwide	5%
South Africa	Johannesburg	42%
	Tshwane (Pretoria)	24%
Spain	nationwide	24% to 34%
Taiwan	nationwide	25%
	Taipei	42%

Source: Sandra Postel and Amy Vickers, "Boosting Water Productivity" (Chapter 3), ***State of the World 2004*** (W.W. Norton, New York, 2004).

Case Study: 4 small Vermont cities

- **UFW ranged from 37 to 46% in 3 out of 4**
- Outdated water source meter and billing records, tracking system
- Oversized meters, under registering meters, irregular audits
- $40k-$400k annual UFW cost
- < 1yr payback potential on under-recorded use alone

Residential Performance Indicators

Benchmarks for Water Efficiency: *Single Family* Residential

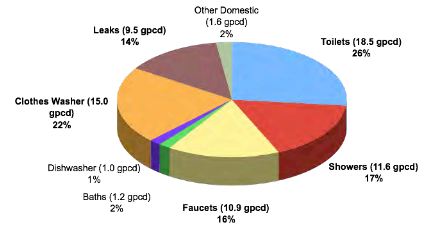
- ***Single Family* Residential Indoor Water Use**
  - U.S. Avg: 69.3 gpcd (AWWARF survey, 1999)
  - Today BAT fixtures and appliances: 35-45 gpcd
  - Future: < 35 gpcd
- ***Single Family* Residential Outdoor Water Use**
  - U.S. Avg: not known
    - 101.9 gpcd (1200 SF homes, primarily Western US)
    - actual: 0-1000s gpcd
  - Today: outdoor use is increasing, sometimes exceeding indoor demand

Benchmarks for Water Efficiency: *Multi-Family* Residential

- ***Mutli-Family*** **Residential Indoor Water Use**
  - MF gpcd ranges from about 40 gpcd to 60 gpcd
    - MF gpcd not well documented
  - Same types of uses as SF but clothes washer and dishwasher use is less
  - Higher leakage rates typical in low income properties, public housing
- ***Mutli-Family*** **Residential Outdoor Water Use**
  - Often little or none, especially in cooler regions and low income properties
  - High-income MF properties are higher due to pools, lawns

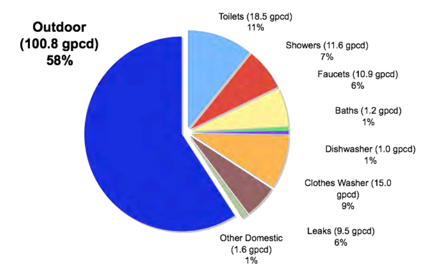
1999 AWWARF RESIDENTIAL END USES OF WATER STUDY 0F 1200 HOMES IN WESTERN US, CN & TAMPA:

69.3 GPCD INDOOR--SINGLE FAMILY



1999 AWWARF RESIDENTIAL END USES OF WATER STUDY 0F 1200 HOMES IN WESTERN US, CN & TAMPA

170.1 GPCD INDOOR & OUTDOOR--SINGLE FAMILY



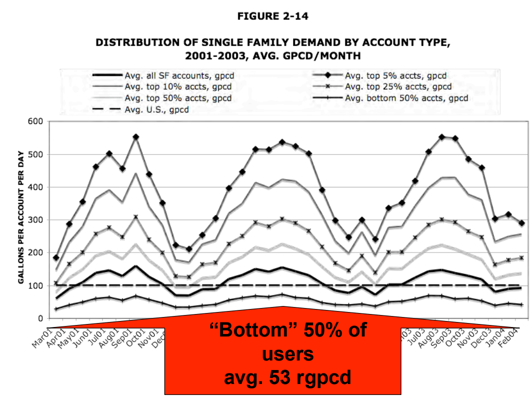
SF Residential Water Use Sampler

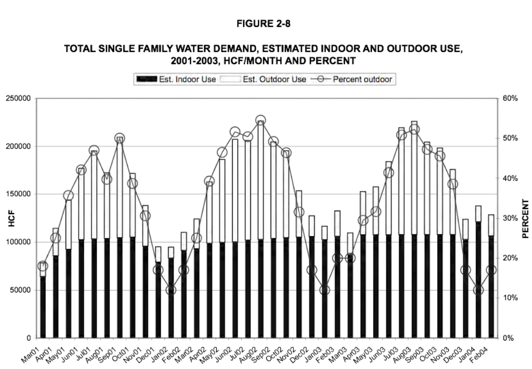
- **Averages**
  - Scottsdale, AZ., 203 gpcd
  - Denver, CO, 159 gpcd
  - Tucson, AZ, 107 gpcd
  - USA, 101 gpcd (USGS)
  - Atlanta (metro), GA, 85 gpcd
  - United Kingdom, 39 gpcd
- **Example: Average don't tell the whole story!**
  - Avg. SF water use: 111 gpcd
  - *Avg. top 5% SF water use: 396 gpcd!*

Example: SINGLE FAMILY DEMAND BY ACCOUNT TYPE, GD/ACCOUNT AND GPCD

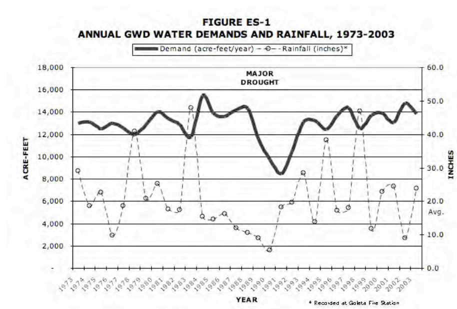
Single Family Account Water User Type*	Avg. Single Family Water Use, GD/Account	Avg. GPCD (1)	Indoor		Outdoor	
			GPCD	%	GPCD	%
Top 5%	1137	396	69.5	18%	327	82%
Top 10%	904	315	69.5	22%	246	78%
Top 25%	642	224	69.5	31%	154	69%
Top 50%	479	167	69.5	42%	98	58%
Average	**319**	**111**	**69.5**	**63%**	**42**	**37%**
Bottom 50%	152	53	NK	NK	NK	NK
Avg. U.S. (4)	*290*	*101*	*69.5*	*69%*	*32*	*31%*

Water Conservation Plan 2005, Goleta Water District, Calif., Amy Vickers & Associates, Inc.





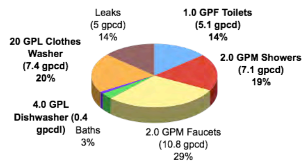
GWD Drought Restrictions: 40% Savings



Water Conservation Plan 2005, Goleta Water District, Calif., Amy Vickers & Associates, Inc.

2006 RESIDENTIAL WATER USE WITH
HIGH-EFFICIENCY FIXTURES & APPLIANCES

37.0 GPCD INDOOR–SINGLE AND MULTI-FAMILY



MA’s 65 rgpcd performance indicator is generous.

MA 65 rgpcd
– HET 37 rgpcd
= **28 rgpcd indoor savings potential that exists today (43% reduction**)

“Washing machine uses ozone to recycle water” –*WaterTech Daily, 2/3/06*

- **About 13 gal/wash**
  - 50 L/wash
- $2,100
- Drum washer/dryer changes air to ozone, recycles final rinse water
- Reduced odor, bacteria, wear and tear

New Hitachi Water-Saving Dishwasher/Dryer

- **About 2.6 gal/wash**
  - 9.8 L/wash
- Ultra-fine steam loosens food residue from dishes

Facts: Essential and Nonessential Human End Uses of Water

- Essential Water Uses (Indoor)
  - Toilet
  - Shower
  - Bathtub
  - Faucet
  - Dishwashing
  - Clothes washing
  - Dog/cat water bowl
- Nonessential Water Uses (Outdoor)
  - Lawn irrigation
  - Pool
  - Garden water feature, fountain
  - Fish pond

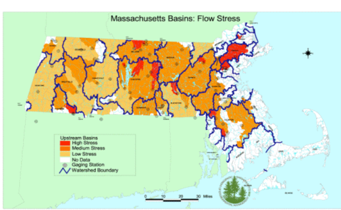
Purpose of the MassDEP Water Management Policy

"… provide protection to stream flows in stressed riversheds, by reducing the residential per capita consumption of water during periods of low water flow. Particularly during dry summers, flow in several Massachusetts rivers is severely impacted by water withdrawals. **Recognizing the need to balance essential human needs against the health of the riverine ecology**, **MassDEP has pushed for the reduction in non-essential summer use, particularly automated lawn sprinklers, reduction in water system leaks, and better measurement of so-called 'unaccounted for water'-** water that is withdrawn and treated, but which is not charged to any particular customer."

Source: Mass. Office of Commonwealth Development, "Water Management Act- Blue Ribbon Panel," http://www.mass.gov/?pageID=ocdterminal&&L=2&L0=Home&L1=Environment&sid=Eocd&b=terminalcontent&f=ocdfrontpage_wmablueribbonpanel&csid=Eocd (Accessed Oct. 2006)

Human Water *Wants* vs. Water *Needs*

We have enough water to meet our needs, but how long can we afford to sacrifice the health of our water sources to meet our water wants?



Source: Massachusetts DEP, http://www.mass.gov/dep/water/priorities/sggwhome.htm, accessed October 2006.

Reported New Irrigation Wells in Massachusetts, 2000-2005: 6,785

- Does not include non-reported new irrigation wells
- Most east of 495

  Source: MA DCR, Sept. 2006
- Irrigation wells can typically supply *thousands of gallons of water a day*–for free
- Left and coming west: new housing development, Amherst, MA, 2005

Photo by Amy Vickers, Amherst, MA., 2005

The Nature Conservancy's Drinking Water Sustainability Certification Project

Source: Postel and Richter, *Rivers for Life: Managing Water for People and Nature.* Island Press, Washington DC. 2003.

- US: declining river and stream flows affecting tourism and recreational economies, ecosystem services
- Excessive withdrawals for water supplies play major role
- Draft water utility certification criteria: preservation of environmental flows, benchmarks for water efficiency/conservation, source protection
  - Integrated Water Resource Management (IWRM)
  - Performance based

Outdoor Water Use

To drain or sustain our water supplies?

"New Directions in Lawn and Landscape Water Conservation"

–Vickers, *JR AWWA, Feb06*

1. Limit the number of watering days per week–or month.
2. Reduce area allowed for irrigation.
3. Upgrade Xeriscape principles.
4. Stop the escalating lawn chemical-watering cycle.
5. Promote natural lawns and landscapes: Irrigate by rainwater only.

1. Limit the number of watering days per week–or month.

- Voluntary watering schedules don't save water
- Mandatory restrictions save water–if schedules are designed properly
  - 1-2 days/week
  - 3 days/*month*

Example: Lawn Watering Restrictions (Schedule Effectiveness Varies)

Univ. of Colorado study of 8 cities (2002)

- **Voluntary watering restrictions "just didn't help that much"** to compel people to reduce use during Colorado's '02 severe drought–*some even used more water!*
  - Two cities saved only 3%, two others experienced increased water use (2%, 7%)
- ***Every-third-day*** schedule: 14% water savings
- Mandatory ***twice-a-week*** schedule: 30% water savings
- Mandatory ***once-a-week*** schedule: 53% savings

2. Reduce Area Allowed for Irrigation

- Same idea as ordinances that restrict % of high-water using plants and turf–they work!
- Most irrigation is for turf; established turf can survive on rainwater only
- "Functional turf area" oxymoron?
  - Kids today spending less time in yards
  - *Last Child in the Woods,* Richard Louv
    - TV, video games, computer/Internet
    - Disinterested, fear-based connection to nature

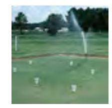


Photo: So. Florida Water Mgmt District

Limit or Prohibit Landscape Water Features - Not So Natural or Water Friendly!

- Growing market: 16 million American households had water gardens in 2003 (4 million in 1998)
- Water use: flows 500 gph and >4000 gph
- Equipment and supply heavy:
  - high-tech filters, sterilizers, vacuum cleaners, "leaf eaters," weed killers, plant and fish food, antibiotics, heaters
- Fish kills - treatment chemical overload, predators, power outages
- Introduction of invasive plants, fish
- New outdoor water use, conservation target

3. Upgrade Xeriscape Principles (or even better, avoid Xeriscape?)

- Many have negative associations with "Zero-scape"
- Xeriscape born 1981: qualitative approach to savings
- Phoenix: 18 Xeric properties used *30% more water!*
- "Xeriscape Conversion Study" So. Nevada Water Authority,2005.
  - 96,000 gallons (30%) savings per household, BUT
  - Net 120,000 gal/year xeric property use!

4. Stop the Escalating Lawn Chemical-watering Cycle

- High lawn water use is correlated to chemical use
- Typical SFR high water volume lawns
  - In-ground, automatic irrigation systems
  - Fertilizer, chemical treatments require "watering in"
  - Perfect green lawn, "Your lawn on drugs"
- Lawn chems are contributors to water quality degradation
  - Eutrophication, higher treatment costs, human and animal health risks (Perdue Univ. canine study)
- Concord, MA: focus group of top residential users
  - 75% have in-ground sprinkler systems
  - *All* use fertilizers and pesticides on their properties

Anti-Lawn Chemical Movement

- **Canada: nearly 70 cities and towns prohibit lawn chemicals**
  - Upheld by Canadian Supreme Court, Nov05
  - More bans expected
- **United States**
  - Cleveland Heights, Ohio
  - Madison and Dane County, WI (fertilizers)
  - **Connecticut**, statewide law passed in 2005
    - Day care centers: *pesticides prohibited*
    - Elementary schools: IPM allowed for 3 years, then pesticides fully prohibited
    - Emergency exemptions (e.g., West Nile virus)

5. Promote Natural Lawns and Landscapes: Irrigate by Rainwater Only

- Irrigation-free lawns, landscapes and golf courses have always been with us
- Prairie Crossing, Illinois
  - 359 single family home subdivision
    - Only 2 homes irrigate
  - 30-acres common area turf–no irrigation
  - Community organic farm, drip system

References

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